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writings the warm friendship of astronomers everywhere, even though they had not met him. Several years ago, when PROCTOR, the eminent English astronomer, was in this country, this incident occurred: PROCTOR lectured in Indianapolis. After the lecture a professor from a sister institution approached him and invited him to his town to lecture the next night. PROCTOR said: "No; I came to America to see Dr. KIRKWOOD. To-morrow is my opportunity, and I am going to Bloomington to see him."

Eighteen years ago, when I was an assistant of Dr. KIRKWOOD, I wrote and published this paragraph:—

"'When I die, I want to go where Dr. KIRKWOOD goes,' was the simple eulogy of one of his admirers. Whatever may be said of this sentiment, certain it is that during fifty years as a teacher, he has gained from his students such universal love and admiration as few men can enjoy, and while as a mathematician he has made many valuable contributions to science, as a genial, temperate, and genuine man, he has solved the problem of gracefully growing old."

In intellect he was keen, logical, and far-seeing. In integrity he was without reproach. He was "spotless before the world." In private character he was pure as an infant. He was in sympathy with humanity. He was as natural as a child and as free from self-conceit as the "lilies of the field." He saw and spoke the truth. The laws of Nature were to him the laws of God. The heavens indeed declared His glory. In revealing the secrets of the stars he revealed the beauty of his life. KIRKWOOD the scientist we admire, but KIRKWOOD the man we love. These characteristics made DANIEL KIRKWOOD one of the greatest of Indiana's roll of heroes and one of the most lovable of men of any country or age.

PLANETARY PHENOMENA FOR SEPTEMBER,
OCTOBER, NOVEMBER, AND DECEMBER, 1901.

By MALCOLM MCNEILL.

SEPTEMBER.

The Sun crosses the celestial equator and autumn begins September 23d, 10 A.M. Pacific time.

Mercury is an evening star throughout the month, having passed superior conjunction on August 27th. At the close of

the month it is well out toward east elongation, but the great southern declination of the planet makes the interval between sunset and the setting of the planet too short for naked-eye visibility of the planet.

Venus is an evening star. It increases its distance from the Sun from 32° to 37° , and it remains above the horizon a few minutes longer after sunset than during August. At the end of September the interval is about an hour and a half. It moves 33° east and 14° south through *Virgo* into *Libra*. On September 8th it passes about 3° north of the first-magnitude star *Spica*.

Mars is much nearer the Sun and sets earlier than during August. Its distance from us increases about twelve millions of miles, and it is about twice as far from us as we are from the Sun. Its apparent motion among the stars is 20° east and 7° south from *Virgo* into *Libra*, and at the end of the month it is about 4° east of *Venus*, which is rapidly overtaking it.

Jupiter and *Saturn* remain in *Sagittarius*, and are quite conspicuous in the southwestern sky in the evenings. *Jupiter* has ceased his retrograde motion and is again moving eastward, but not rapidly as yet, making about $1^{\circ} 41'$ during the month. *Saturn* keeps up his westward motion until September 14th, and then begins to move eastward, but the whole motion is only about $15'$, and, as far as naked-eye observations show, the planet is practically stationary among the stars. *Jupiter* and *Saturn* approach each other a little more than 1° , and on September 30th they are not quite 6° apart.

Uranus is about two hours' motion ahead of *Jupiter* and *Saturn*, and its distance from the Sun is getting to be too small for convenient evening observations. It remains above the horizon until nearly 9 P.M. on September 30th; but its small size makes observation difficult unless the planet is at a good altitude.

Neptune is an early morning object.

OCTOBER.

There will be a partial eclipse of the Moon, on October 27th, not visible in any part of the western hemisphere except Alaska, but visible generally throughout the eastern hemisphere, except in western Europe. At the maximum only about one quarter of the Moon's diameter will be covered.

Mercury is an evening star, and comes to greatest east elongation on the morning of October 12th; but its very great southern

declination (12° south of the Sun) makes the interval between the setting of the Sun and planet less than one hour, and although the elongation (25°) is comparatively large, being only a fortnight from aphelion, the planet will scarcely be visible to the naked eye.

Venus is increasing its apparent distance from the Sun, and by the close of the month the elongation will be more than 40° . The interval from sunset to the setting of the planet increases, and is well over two hours by the end of the month. The planet moves about 35° eastward and 8° southward among the stars from *Libra* through *Scorpio* and into *Ophiuchus*. On the morning of October 9th it overtakes and passes *Mars*, also moving in the same general direction but more slowly. At the time of nearest approach *Venus* is a little less than 1° south of *Mars*. *Venus* also is in conjunction with *Uranus* on the morning of October 25th, the former being $2^{\circ} 21'$ south.

Mars is still in the southwestern sky in the early evening, but sets less than two hours after sunset, and has become so faint as to be no longer conspicuous. It is nearly at its maximum distance from us, but will not reach it for several months. It moves about 21° east and 5° south from *Libra* through *Scorpio*.

Jupiter and *Saturn* still keep their position in *Sagittarius*, and by the close of the month remain above the horizon less than four hours after sunset. Both are moving eastward among the stars, *Jupiter* 4° and *Saturn* a little more than 1° during the month, and by the end they are less than 3° apart.

Uranus is nearer the Sun than during September, and by the end of the month sets about two hours after sunset. It is rather too low down to be seen with the naked eye.

Neptune is rising earlier, and is well up during the late evening.

NOVEMBER.

There will be an annular eclipse of the Sun on November 10th, not visible in the western hemisphere. The central line runs from the Mediterranean Sea through Egypt, Arabia, the Indian Ocean, just touching southern Hindustan and Siam, and ending in the Philippines.

Mercury passes inferior conjunction with the Sun and becomes a morning star on November 4th. It rapidly recedes from the Sun, and after November 11th it rises more than an hour before sunrise. It reaches greatest west elongation on November 20th, and then rises more than an hour and a half before sunrise. This

is the best opportunity of the year for seeing *Mercury* as a morning star.

All of the other planets, except *Neptune*, are in the southwestern sky in the early evening, but some of them are too near the Sun for easy observation. *Venus* reaches nearly its maximum distance from the Sun, and by the close of the month sets more than three hours after sunset. It moves about 33° westward and 2° northward from *Ophiuchus* through *Sagittarius* into *Capricorn*, passes *Jupiter* on November 17th, and *Saturn* on November 18th. For several days the three planets are near each other, *Venus* being about 3° south of the other two. This close conjunction of three bright planets is a very unusual occurrence.

Mars is down below *Venus*, and toward the close of the month will not be a very easy object, but can still be made out in good weather conditions. It moves eastward about 22° from *Scorpio* through *Ophiuchus* into *Sagittarius*. It passes *Uranus* less than 1° south on the night of November 3-4th, and at the close of the month is about 10° from *Jupiter* and *Saturn*.

Jupiter and *Saturn* are still high enough to be seen in the early evening. Both are moving rapidly eastward from the constellation *Sagittarius* toward *Capricorn*. They come to conjunction on the evening of November 27th, *Jupiter* then being $0^{\circ} 27'$ south of *Saturn*, a distance rather less than the Moon's diameter. At the beginning of the month *Jupiter* was about 3° west of *Saturn*.

Uranus is drawing closer to the Sun and by the end of the month sets only a half an hour after sunset.

DECEMBER.

The Sun passes the solstice and winter begins December 22d, 4 A.M., P. S. T.

The Earth is in perihelion December 31st, 10 P.M., P. S. T.

Mercury is a morning star at the beginning of the month, rising about an hour and a half before sunrise, but is approaching the Sun. The interval between the rising of the planet and the Sun is, however, more than an hour until after December 10th. After that it is too near the Sun to be seen, and by the end of the month it has nearly reached superior conjunction. It is in conjunction with *Uranus* on the morning of December 18th.

Venus reaches its greatest east elongation on December 4th. It is then $47^{\circ} 19'$ from the Sun, and by the end of the month the

distance will have diminished about 4° . Owing to the relative motions of the Sun and planet in declination, however, the interval between sunset and the setting of the planet will go on increasing throughout the month, being more than three hours and a half toward the close. *Venus* has been gradually increasing in brightness as it moved out toward greatest elongation, and will still farther increase until about half-way between that point and inferior conjunction. The maximum will occur during January, 1902.

Mars is gradually being overtaken by the Sun in their common eastward motion, but will not set until about an hour and a half after sunset throughout the month. It is growing so faint that weather conditions must be very good in order to see it. It passes $1^{\circ} 19'$ south of *Saturn* on the morning of December 14th, and $0^{\circ} 52'$ south of *Jupiter* on the morning of December 17th. For several days the three planets are very close together.

Jupiter and *Saturn* are drawing close to the Sun, and by the close of the month both set less than an hour after sunset. It will be hardly possible to see *Saturn* for the last week or so, but *Jupiter*, on account of its greater brightness, may remain visible throughout the month. Both planets are still moving eastward among the stars, but the greater motion of *Jupiter* causes them to separate, and on December 31st *Jupiter* will be about 4° east of *Saturn*.

Uranus is too near the Sun to be seen and passes conjunction on the afternoon of December 9th.

Neptune is in opposition with the Sun on December 24th.

SEPTEMBER-OCTOBER, 1901.

PHASES OF THE MOON, P. S. T.

Last Quarter . . .	Sept. 5,	5 ^h	27 ^m	A. M.
New Moon . . .	Sept. 12,	1	18	P. M.
First Quarter . . .	Sept. 20,	5	33	
Full Moon . . .	Sept. 27,	9	36	
Last Quarter . . .	Oct. 4,	12	52	
New Moon . . .	Oct. 12,	5	11	A. M.
First Quarter . . .	Oct. 20,	9	58	
Full Moon . . .	Oct. 27,	7	6	

THE SUN.

1901.	R. A.	Declination.	Rises.	Transits.	Sets.
Sept.	1, 10 ^h 40 ^m	+ 8° 27'	5 ^h 31 ^m A.M.	noon	6 ^h 29 ^m P.M.
	11, 11 16	+ 4 44	5 41	11 ^h 57 ^m A.M.	6 13
	21, 11 52	+ 0 53	5 50	11 53	5 56
Oct.	1, 12 28	- 3 1	6 0	11 50	5 40
	11, 13 4	- 6 52	6 11	11 47	5 23
	21, 13 42	- 10 33	6 21	11 45	5 9
	31, 14 20	- 13 59	6 32	11 44	4 56

MERCURY.

Sept.	1, 10 59	+ 8 14	5 51 A.M.	12 19 P.M.	6 47 P.M.
	11, 12 2	+ 0 26	6 42	12 43	6 44
	21, 12 59	- 6 55	7 24	1 0	6 36
Oct.	1, 13 51	- 13 18	7 59	1 13	6 27
	11, 14 36	- 18 13	8 22	1 18	6 14
	21, 15 6	- 20 44	8 23	1 9	5 55
	31, 14 55	- 18 29	7 24	12 19	5 14

VENUS.

Sept.	1, 12 41	- 3 48	8 13 A.M.	2 1 P.M.	7 49 P.M.
	11, 13 25	- 8 52	8 36	2 5	7 34
	21, 14 9	- 13 38	8 58	2 11	7 24
Oct.	1, 14 56	- 17 54	9 20	2 17	7 14
	11, 15 43	- 21 28	9 43	2 26	7 9
	21, 16 33	- 24 9	10 4	2 36	7 8
	31, 17 23	- 25 47	10 23	2 47	7 11

MARS.

Sept.	1, 13 53	- 11 58	9 54 A.M.	3 13 P.M.	8 32 P.M.
	11, 14 18	- 14 19	9 48	2 59	8 10
Oct.	21, 14 45	- 16 33	9 44	2 46	7 48
	1, 15 13	- 18 36	9 39	2 34	7 29
	11, 15 42	- 20 25	9 36	2 24	7 11
	21, 16 12	- 21 58	9 34	2 15	6 56
	31, 16 43	- 23 11	9 30	2 6	6 42

JUPITER.

Sept.	1, 18 14	- 23 31	2 59 P.M.	7 33 P.M.	12 7 A.M.
Oct.	1, 18 21	- 23 31	1 8	5 42	10 16 P.M.
Nov.	1, 18 39	- 23 21	11 23 A.M.	3 58	8 33

SATURN.

Sept.	1, 18 43	— 22 43	3 23	P.M.	8 2 P.M.	12 41 A.M.
Oct.	1, 18 44	— 22 46	1 25		6 4	10 43 P.M.
Nov.	1, 18 50	— 22 41	11 30	A.M.	4 9	8 48

URANUS.

Sept.	1, 16 46	— 22 23	1 26	P.M.	6 5 P.M.	10 44 P.M.
Oct.	1, 16 49	— 22 28	11 31	A.M.	4 10	8 49
Nov.	1, 16 54	— 22 38	9 36		2 14	6 52

NEPTUNE.

Sept.	1, 6 5	+ 22 17	12 6	A.M.	7 26 A.M.	2 46 P.M.
Oct.	1, 6 6	+ 22 16	10 9	P.M.	5 29	12 49
Nov.	1, 6 6	+ 22 15	8 6		3 26	10 46 A.M.

ECLIPSES OF JUPITER'S SATELLITES, P. S. T.

(Off right-hand limb as seen in an inverting telescope.)

III, R, Sept.	2, 4 ^h 39 ^m	P. M.	I, R, Oct.	1, 2 ^h 33 ^m	P. M.
II, R,	4, 8 46		II, R,	6, 8 38	
I, R,	6, 7 50		I, R,	8, 4 28	
III, D,	9, 5 35		III, R,	15, 4 45	
III, R,	9, 8 40		I, R,	15, 6 23	
IV, D,	11, 10 39		III, D,	22, 5 35	
II, R,	11, 11 24		III, R,	22, 8 45	
I, R,	13, 9 45		I, R,	24, 2 47	
I, R,	15, 4 14		II, R,	24, 3 13	
III, D,	16, 9 35		I, R,	31, 4 42	
II, R,	22, 3 22		II, R,	31, 5 52	
I, R,	22, 6 9				
IV, D,	28, 4 40				
IV, R,	28, 7 47				
II, R,	29, 6 0				
I, R,	29, 8 4				

NOVEMBER-DECEMBER, 1901.

PHASES OF THE MOON, P. S. T.

Last Quarter, . . .	Nov. 2,	11 ^h 24 ^m	P. M.
New Moon, . . .	Nov. 10,	11 34	
First Quarter, . . .	Nov. 19,	12 23	A. M.
Full Moon, . . .	Nov. 25,	5 18	P. M.
Last Quarter, . . .	Dec. 2,	1 50	
New Moon, . . .	Dec. 10,	6 53	
First Quarter, . . .	Dec. 18,	12 35	
Full Moon, . . .	Dec. 25,	4 16	A.M.

THE SUN.

1901.	R. A.	Declination.	Rises.	Transits.	Sets.
Nov.	1, 14 ^h 24 ^m	— 14° 18'	6 ^h 33 ^m A.M.	11 ^h 44 ^m A.M.	4 ^h 55 ^m P.M.
	11, 15 4	— 17 19	6 44	11 44	4 44
	21, 15 45	— 19 50	6 57	11 46	4 35
Dec.	1, 16 28	— 21 45	7 7	11 49	4 31
	11, 17 11	— 22 59	7 16	11 53	4 30
	21, 17 55	— 23 27	7 23	11 58	4 33
	31, 18 40	— 23 8	7 27	12 3 P.M.	4 39

MERCURY.

Nov.	1, 14 51	— 17 53	7 14 A.M.	12 11 P.M.	5 8 P.M.
	11, 14 13	— 11 35	5 32	10 53 A.M.	4 14
	21, 14 29	— 12 14	5 12	10 30	3 48
Dec.	1, 15 19	— 16 47	5 39	10 41	3 43
	11, 16 20	— 21 10	6 16	11 2	3 48
	21, 17 26	— 24 3	6 57	11 29	4 1
	31, 18 36	— 24 53	7 32	noon	4 28

VENUS.

Nov.	1, 17 28	— 25 54	10 25 A.M.	2 48 P.M.	7 11 P.M.
	11, 18 18	— 26 17	10 37	2 59	7 21
	21, 19 7	— 25 31	10 43	3 8	7 33
Dec.	1, 19 54	— 23 43	10 41	3 15	7 49
	11, 20 36	— 21 4	10 32	3 17	8 2
	21, 21 12	— 17 46	10 17	3 15	8 13
	31, 21 43	— 14 9	9 53	3 5	8 17

MARS.

Nov.	1, 16 46	— 23 17	9 29 A.M.	2 5 P.M.	6 41 P.M.
	11, 17 18	— 24 5	9 26	1 58	6 30
	21, 17 51	— 24 28	9 22	1 52	6 22
Dec.	1, 18 24	— 24 24	9 16	1 46	6 16
	11, 18 58	— 23 53	9 8	1 40	6 12
	21, 19 32	— 22 55	8 57	1 34	6 11
	31, 20 5	— 21 30	8 45	1 28	6 11

JUPITER.

Nov.	1, 18 39	— 23 21	11 23 A.M.	3 58 P.M.	8 33 P.M.
Dec.	1, 19 3	— 22 53	9 47	2 24	7 1
Jan.	1, 19 33	— 22 0	8 11	12 52	5 33

SATURN.

Nov.	1, 18	50	— 22 41	11 30	A.M.	4 9	P.M.	8 48	P.M.
Dec.	1, 19	2	— 22 28	9 44		2 23		7 2	
Jan.	1, 19	17	— 22 6	7 55		12 36		5 17	

URANUS.

Nov.	1, 16	54	— 22 38	9 35	A.M.	2 14	P.M.	6 53	P.M.
Dec.	1, 17	2	— 22 49	7 45		12 23		5 1	
Jan.	1, 17	10	— 23 0	5 52		10 29	A.M.	3 6	

NEPTUNE.

Nov.	1, 6	6	— 22 15	8 6	P.M.	3 26	A.M.	10 46	A.M.
Dec.	1, 6	3	— 22 15	6 6		1 26		8 46	
Jan.	1, 5	59	— 22 15	3 57		11 17	P.M.	6 37	

ECLIPSES OF JUPITER'S SATELLITES, P. S. T.

(Off right-hand limb as seen in an inverting telescope.)

I, R, Nov.	7,	6 ^h 37 ^m	P. M.	II, R, Dec.	1,	5 ^h 43 ^m	P.M.
I, R,	16,	3 0		IV, D,	4,	4 51	
I, R,	23,	4 55		I, R,	9,	3 13	
II, R,	25,	3 6		I, R,	16,	5 8	
III, R,	27,	4 50					
I, R,	30,	6 50					